will emphasize the essence of two classes of architectural models, which approach tree modelling using recursive or self-organizing techniques; the modelling of endogenous signals that coordinate tree development, the creation of tree models responding to environmental input; and the modelling of the feedback loop of interactions between a tree and its environment. I will also show how small modifications of the models and their parameters yield diverse tree forms observed in nature. These general concepts will be illustrated using case studies of simulating carbon allocation and partitioning, plant-light interaction, and the effects of management practices. The talk will be concluded by highlighting open problems concerning functional-structural tree modeling in the context of environmental interactions.

SESSION 6: Modelling within-tree procesess

OS 6-1:

ASSESMENT OF THE ROLE OF AGE AND LIGHT AVAILABILITY IN LEAF MORTALITY IN MANGO TREE

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The branch autonomy principle states that the branch carbohydrate economy can be largely independent of the other branches of a tree. This may influence fruit growth and affect global crop yield. While this concept has already been tested on different fruit tree species, branch autonomy has not been characterized with respect to fruit growth in the mango tree. The mango tree, a major fruit production in tropical and subtropical regions, exhibits phenological asynchronisms indicating decorrelated development of branches within a tree and thus a possible autonomy among them. To assess this autonomy, we used a quantitative model of the vegetative and reproductive development of mango tree architecture and fruit quality. This functional-structural plant model combines complementary architectural, phenological and ecophysiological knowledges and relies on two sub-models parameterized for the cultivar Cogshall in Réunion Island. The first sub-model simulates stochastically the development of mango tree architecture, growth units and inflorescences, based on empirical rules. A recent improvement was to take into account leaf mortality to achieve more realistic foliage distribution. Fruit growth and quality development are simulated by a second sub-model that simulates carbon- and water-related processes occurring at the fruiting branch scale during the fruit-growing season. This model assumes the independence of the fruiting branches in terms of carbohydrates synthesis and allocation. We conducted a sensitivity analysis on the size of the fruiting branches and compared the simulated and measured fruit fresh masses at maturity in order to assess the level of autonomy of the branches regarding carbohydrates supply for fruit production. Our results show that the leaf to fruit ratio and the simulated fruit fresh mass increase proportionally with the size of the branches. The comparison with measured fruit masses indicates that a branch size of 2 to 3 GUs are sufficient with respect to fruit growth.

Keywords:Mangifera indica, tree architecture, functional-structural plant model, carbon allocation, 3D digitizing

OS 6-2:

ARCHITECTURAL FACTORS AFFECT FRUIT SET IN MANGO: EVIDENCE AND MODELLING

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